Center Innovation Fund: GSFC CIF

Tunable, Resettable, Printable, Impact Energy Absorbing Matrix

Completed Technology Project (2017 - 2018)

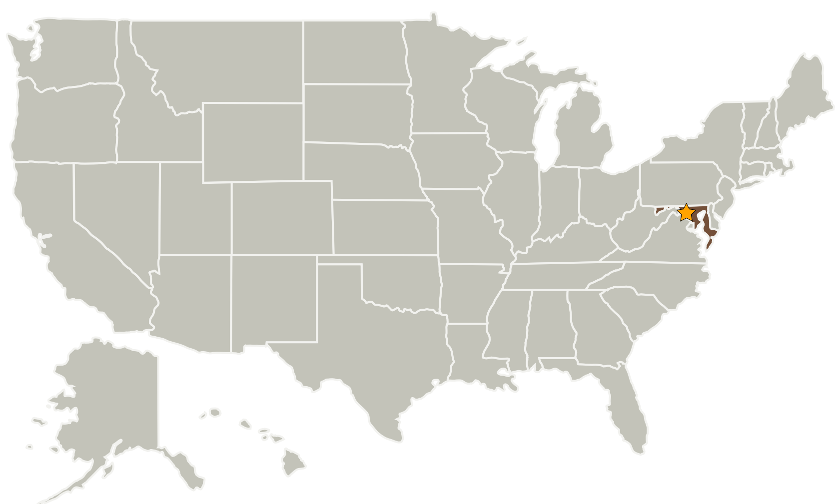
Project Introduction

Landing on a largely unknown planetary surface imposes risks to the structure of the lander. This effort seeks to reduce the risk of energy absorption in two ways. Primarily it provides a method of fully characterizing an energy absorbing material through analysis verified by testing. Secondly, since energy absorbing elements will likely need to be constrained geometrically (such as within a cartridge enclosure), this effort would provide the basis for a CAD model that could easily be changed late in the design process without having to change the supporting structure. The ability to custom 3D print energy absorbing materials/substructure would greatly support flexibility in future lander designs. This effort will begin with 2D and 3D printed plastic prototypes, followed by development of a 3D printed titanium prototype. Test results for the titanium prototypes are due by the end of the FY.

Anticipated Benefits

If successful, this technology would have opened up new design possibilities and landing options. Testing revealed that the idea could not compete mass-wise with conventional approaches.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
⭐Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations
Maryland

Project Transitions

October 2017: Project Start

September 2018: Closed out

Closeout Summary: Landers on extraterrestrial bodies may adversely affect the targets' surfaces because they land too hard . The goal of this CIF was to produce a 3-D printed, energy-absorbing, spring-like prototype that could absorb impact energy. From a design standpoint, the absorber should be characterizable and tunable. To achieve these goals, the design required the material stresses be kept below the yield point. Due to the amount of energy absorbed being limited by the yield stress of the material, it was discovered that the concept required designs that would have too much mass and would also be too geometrically inefficient for the envisioned missions. Although much was learned with developing single-print mechanisms that may have tangential benefits, the core concept was determined to be impractical. It was found that crushable material, which exceeds the yield point, can absorb orders-of-magnitude more energy than the spring-like concepts that formed the basis of this concept.

Project Website:

https://www.nasa.gov/directorates/spacetech/innovation_fund/index.html#.VC

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Center Innovation Fund: GSFC CIF

Project Management

Program Director:

Michael R Lapointe

Program Manager:

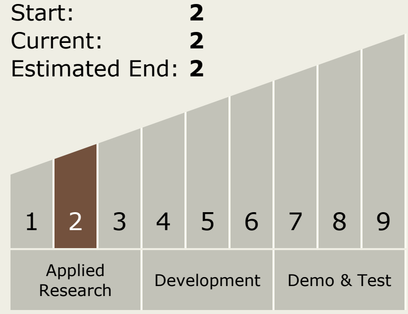
Peter M Hughes

Principal Investigator:

Andrew E Jones

Technology Maturity (TRL)

Start: **2**
Current: **2**
Estimated End: **2**



Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  └ TX12.4 Manufacturing
    └ TX12.4.6 Repurpose Processes

Target Destination

Others Inside the Solar System